SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

CONVERTED "TANK" AS A MOUNTAIN CLIMBER.-- (See page 513).

Vol. CXXI No. 21
November 22, 1919

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 10 Cents
$5.00 a Year

Entered as second class matter June 18, 1879, at the post office at New York, N. Y.

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SEVENTY-FIFTH YEAR

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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NEW YORK, NOVEMBER 22, 1919

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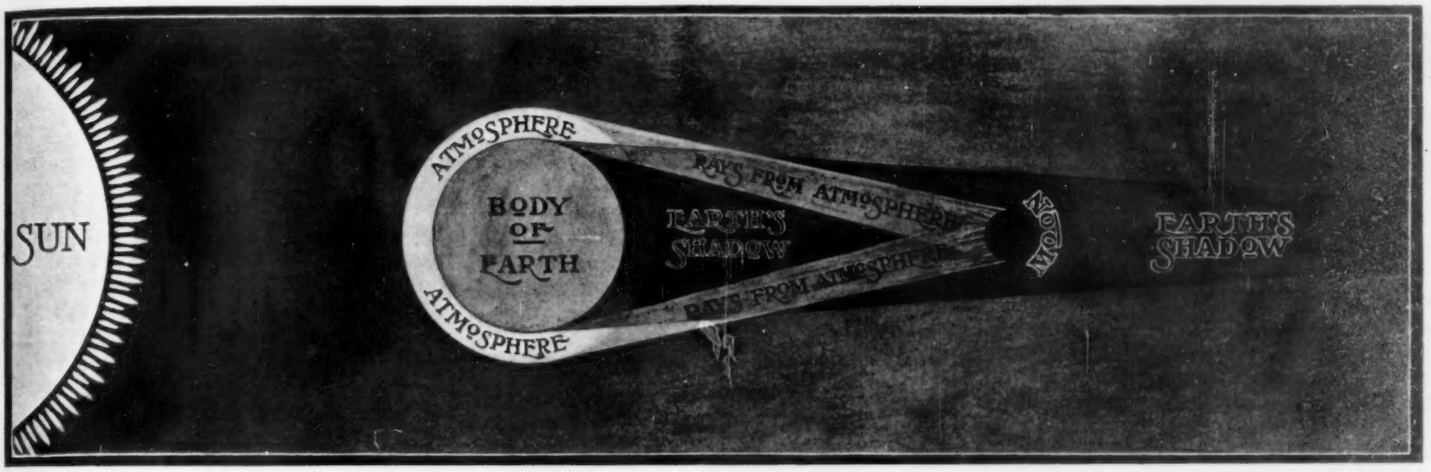


HOW LIGHT, REFRACTED BY THE EARTH'S ATMOSPHERE, REACHES THE MOON WHEN SHE IS IN ECLIPSE AND MAKES HER VISIBLE

WHY ARE LUNAR ECLIPSES VISIBLE?

We know that our moon possesses no light of her own, and that her silvery beams are merely rays from the sun reaching her surface and then being reflected to us. Therefore, were there no sun she would be utterly invisible. Moreover, we know that a lunar eclipse is caused by our earth's getting between the sun and moon so as to cut off most of the solar light from reaching her surface. But since our earth's body is absolutely opaque, since no light can pass through it, how is it possible for any of the sun's rays to reach the moon's surface when our earth cuts off the sun's light during a total eclipse of the moon? She is thousands of miles distant, and unless some of the solar rays reached her, she should in the middle of a total eclipse be utterly invisible to us.

The explanation is that although none of the sun's rays can pass through our earth, they can pass around it. This is what really happens - a small part of the sunlight is refracted or bent around our earth's surface by means of its atmosphere. Were there no terrestrial atmosphere and were the solar rays not refracted within that atmosphere, the moon, during a total eclipse, would become wholly dark and invisible. Of course, the copper-colored appearance of our satellite at such a time is due to the influence of our earth's atmosphere. The illustration on this page will serve to make clearer this explanation.- C. N. Holmes.

ALCOHOL PRESENTS A SUBSTITUTE FOR ACETYLENE

One of the newer developments in the use of alcohol is its utilization in the separation and purification of gum turpentine. Another relatively new development is its use in the catalytic production of ethylene, which has been considered as a substitute for acetylene in cutting and welding operations. Comparative tests have shown it to possess many advantages over the more usual combustible for this purpose. As far as heat of combustion is concerned, ethylene has a slightly higher coefficient. Moreover, in the working of copper it has been found impossible to make a satisfactory weld with acetylene, because of the formation of carbon and the consequent blistering in the weld. This is not thecase with acetylene; perfect copper welds have been made using it. In addition to its availability for welding copper, the ethylene process of aluminum welding and lead burning makes for much better results than does the use of acetylene. Finally, ethylene has been found to possess considerable value for heating and lighting.

A NEW USE FOR ICE

Up to the present it has been possible to make only small cavities in concrete; but under a new German patent a big advance appears to have been brought about. Pieces of ice, corresponding to the measurements of the cavity required, are embedded in the concrete mass, and small channels are introduced to allow of the rapid removal of the water after melting. In this way not only can small concrete constructions, such as pillars,beams and stairs, be supplied with a hollow space, but large fixed blocks can be made with several chambers, such as are required for walls of houses or ships. The process is of particular advantage in reinforcing concrete with iron. The iron parts are not built in during the stamping, but are attached to the ice blocks before the beginning of the work, which increases its strength. The continual moistening usual in concrete work is rendered unnecessary by the new process, as the loss by evaporation is made good from the melted ice.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845
New York, Saturday November 22, 1919
Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

OUR FIRST RIGID AIRSHIP

We are about to become possessed of our first rigid airship, and it is noteworthy that it will be the largest of its type in existence. We had already mentioned, in these columns, that the Navy Department was considering the acquisition of one of the British airships and announcement is now made that it has been decided to purchase the British rigid dirigible R-38, which is nearing completion in England. The sum of two and one-half million dollars was appropriated by Congress for the purchase of this ship and for the training of the pilots. The statement made public by the Department says that the success of the British in building and operating rigid airships was clinched by the trip of the R-34 to the United States, and its return to England. Although the Germans had many years' start of the British the latter have made remarkable progress in the past few years.

Our new ship in external appearance will look as though she were sister to R-34; but as a matter of fact her dimensions, horse-power, speed and radius of action will be much greater. Those who saw C-5, the latest United States naval dirigible of the non-rigid type, will realize how big a ship is R-38, when it is said that her capacity of 2,724,000 cubic feet is fifteen times that of C-5, which, it will be remembered, after making a record flight between Cape May and Newfoundland was torn from her moorings by a sudden gale, blown out to sea, and lost.

R-34 was 672 feet in length, and of proportionate diameter; but R-38 is 694 feet in length, 86 feet in diameter, and carries a load of 45 tons. Like her predecessor, she is expected to attain the maximum speed of 60 knots. The British Air Ministry has offered to train the personnel for R-38. This offer will probably be accepted, and the new ship be flown across to the United States in charge of her own officers and crew.

NECESSITY NOT THE MOTHER OF INVENTION

One of the many benefits which we are reaping, in partial compensation for the terrible cost of the war, is a clearer, more wide-spread recognition of the inestimable value to the community, of scientific knowledge and scientific methods.

Before the war, we had reached the point of acknowledging the utility of science as a servant. But there was no equally well diffused appreciation of the great value of the scientific investigator as a leader, as one who advances to meet human needs before they are felt. Yet it is in just this that the value of scientific research lies. The born investigator never waits until he can see practical application before setting to work upon a problem. If he did this he would often not only be late in bringing his results into use, but in many cases he would fail to reach any solution at all. For many truths are perceived as links in a chain. The solution of some practical problem may call for an understanding of some of the middle links; but this cannot be realized till some person, from motives which may have nothing to do with this practical problem in question, has forged the first links in the chain.

Again, in many instances, even the existence of a practical problem is not foreseen till the trail has been blazed by some worker in pure science. Hertz would not have produced electrical waves in the laboratory if the genius of Maxwell had never foretold their existence, and even their velocity, twenty years earlier. And Marconi would never even have had an opportunity to exercise his ingenuity in making practical wireless telegraphy an accomplished fact had not Hertz thus forged the second link.

Here invention was born, not of necessity but of opportunity. And the opportunity was furnished by labors pursued and by discoveries made from that sheer curiosity which gropes in the dark to find the light from mere love of light, and without any immediate thought of utility. It is not for nothing that nature has put into the mind of man this spirit of inquiry. By it he is enabled, indeed compelled to gather knowledge before the necessity arise, and to meet the emergency, when it comes, prepared.

Necessity is not the mother of invention; knowledge and experiment are its parents. This is seen clearly in many industrial discoveries; high-speed cutting tools were not a necessity which preceded, but an application that followed, the discovery of the properties of tungsten-chromium alloys; so, too, the use of titanium in arc lamps and of vanadium in steel were sequels to the industrial preparation of these metals and not discoveries made by force of necessity.

It is a poor policy that waits upon necessity to point the way to progress. The man who is wide awake has his eyes open for opportunity; and this antitipates the call of necessity.

The modern version of the old proverb is: Opportunity is the mother of invention

THE ROOT OF THE MATTER

Frequently during the war and since that highly able and representative body of men, the United States Council of National Defense, has addressed itself to the nation in words of instruction and encouragement; but never has it put forward more timely or forceful facts than those in its last statement on the high cost of living.

As a result of a careful investigation it finds that the nation's productive powers have not been fully utilized since the armistice; that too few goods, notably the necessities of life, have been produced; that even some of these goods have been withheld from the market, and therefore from the people; that the high cost of living is due, in part, to unavoidable war waste, and an increase in money and credits; lastly, that there has been and is considerable profiteering, both intentional and unintentional.

The Council tells us that the remedies are: to produce more goods, and to produce in proportion to the need for them; to stamp out profiteering and to stop unnecessary hoarding; to enforce vigorously present laws, and promptly to enact such further laws as are necessary to prevent and punish profiteering and needless hoarding; to bring about better cooperation and methods in distributing and in marketing goods; and, finally, to keep both producer and consumer fully informed as to what goods are required, and what supplies are available, so that production may anticipate the country's demand.

And so, perhaps we shall not be far wrong if we say that this problem is as much a moral as an economic one. We referred some weeks ago to America's moral break-down since the end of the war. This break-down now menaces out material as well as spiritual welfare. Let us check it!

Automobile

COAL GAS AS AUTOMOBILE FUEL.-- In the course of the world war many motor vehicles were operated in England with coal gas because of the scarcity of gasoline. The gas was contained in collapsible bags made of rubberized balloon fabric. At present, however, compressed gas in steel cylinders is being tried. It is stated that the gas is forced in to pressures as high as 2,250 pounds per square inch. The cost of compression is stated to vary between 40 and 75 cents per 1,000 cubic feet of free gas, and the cost as fuel in the engine is equivalent to a cost of 12 cents per gallon on the liquid fuel replaced.

WORN INLET VALVE GUIDES.-- A good deal of the irregularity of running on closed throttle and want of flexibility of the automobile or truck engine can be accounted for if the guides of the inlet valves are worn, especially if some are worn more than others. The valve stems should be a good fit in their guides yet have sufficient freedom to reciprocate easily. If they fit loosely and differently, the amount of air drawn up around them on the suction stroke of the piston will have the effect of interfering, more or less seriously, with the operation, as the mixture drawn into the cylinder will not be the gas determined by the carburetor, but one more or less and always variably thinned out by the air drawn into these leakages. Valve stems and guides should, therefore, be a good working fit and all alike.

VALUE OF AUTOMATIC CONTROL.-- Automatic engine speed control is a valuable contribution to motor truck design and is found on a number of well known American trucks. Its chief object is the prevention of depreciation due to faulty driving and overspeeding. The controller prevents a motor from racing when the clutch is released. It stops wear and tear on the clutch and other mechanism, which results from the clutch being engaged while the engine is running at a high speed. It eliminates shock and strain due to sudden acceleration and too quick application of power. There is also economy of operation, besides a noticeable decrease in the cost of truck maintenance as applying to repair and replacement expense. The controller compels judicious driving, and the saving that it effects is proved by a comparison of operating costs, between vehicles that are automatically governed and those that depend on the judgement of the operator for engine control.

Astronomy

VISIBILITY OF BRIGHT LINES.-- The visibility of lines, both bright and dark, is a subject that has various astronomical applications and has often been investigated by astronomers, including Barnard, Lowell, and others. Dr. Louis Bell has just reported in Science the results of several experiments on the visibility of light-colored lines against a dark background. One of these was made with a white thread 0.008 inch in diameter, stretched zigzag against black paper. The brightness contrast between the thread and the background was about 16 : 1. In sunshine the thread was indistinctly but unmistakably visible at a distance of 300 feet; when the sun went in it was lost at about 200 feet. The general conclusion is that the "minimum visible" for a linear object with strongly contrasted background is about 0.5 second of arc, which is less than 1/50 the "minimum visible" for a round spot giving similar contrast; a remarkable evidence, says Dr. Bell, of the efficient coordination of retinal impressions.

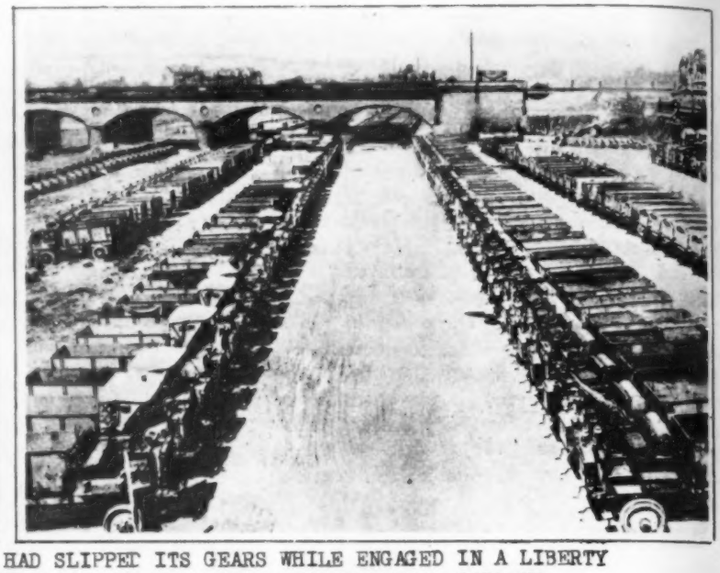
MAGNETIC POLARITY OF SUNSPOTS.--The remarkable discovery of the magnetic field of sunspots made by Hale at Mt. Wilson Observatory in 1908, was the beginning of a series of researches still in progress at the same observatory dealing with the phenomena of the sun. The latest publication on this subject, "The Magnetic Polarity of Sunspots", by Hale, Ellerman, Nicholson and Joy, describes the ingenious methods by which the magnetic polarity of spots is now determined, and the interesting facts revealed by the application of this process. The principal results are thus summarized: The magnetic polarity of a sunspot can be determined by observations of the Zeeman effect in the spectrum of the spot. The inclinations of the lines of force in sunspots can be measured with considerable precision. About 60 per cent of all sunspots are binary groups, (i.e., occur in pairs, with or without attendant minor spots) and it is found that the two principal members of these binary groups, whether single or multiple, are almost invariably of opposite magnetic polarity. Unipolar spots usually exhibit some of the characteristics of bipolar groups. Before the last sunspot minimum the magnetic polarity of unipolar spots and of the preceding (i.e., westerly) members of bipolar spots was positive in the southern hemisphere of the sun and negative in the northern. Since the minimum these signs have been reversed. A scheme has been developed at Mt. Wilson for classifying sunspots on a basis of their magnetic properties.

Electricity

WHY BELGIANS WANT ELECTRIC TRACTION is brought out in a recent issue of Electrical World. The Belgian government has decided to start electrifying its railroads, beginning with the line from Brussels to Antwerp. In this connection it is clear that electric traction has the advantages of distributing motive power along the train, achieving rapid acceleration and higher speeds than are attainable by steam, avoiding smoke and rendering possible the use of water power. Economically, steam lines are cheaper to operate than electric, and the installation costs are lower; but these are counterbalanced by the possibility of running increased freight and passenger service by electric methods.

ELECTRIC POWER COLLECTION.-- Dr. Steinmetz, in a recent issue of the General Electric Review, points out that barriers to further progress are sometimes met in rapidly advancing industries and in electrical engineering. The generation of electric power seems to have reached such a barrier. A motor is a comparatively small unit compared with the huge modern generator. The very size of generating plants has made them more complex, but many of the refinements of controlling and switching mechanisms might be dispensed with in a power unit no larger than a motor unit. The author proposes the use of small generating installations with simple instruments, switches and fuses, to make use of our small water powers and thus conserve our fuel resources.

ELECTRIC SHOCKS.-- The war has brought out additional information as to electric shock. Dr. S. Jellinek, in Elektrotechnik und Maschinenbau, remarks that the shocks resulting from contact with the eletrified wire fences used during the war (usually fed with a pressure of 1,000 volts) varied much in severity. One more important factor was undoubtedly the "state of preparedness" of the victim. Experience has shown that a shock which was likely to prove fatal if received unexpectedly, was harmless when anticipated. Experiments on animals have confirmed this impression and have been instrumental in showing that physiological effects of shocks administered with direct and indirect current are distinctly different. It is also remarked that a close resemblance to death after shock should not be accepted too readily as proof. Persons apparently dead have not infrequently recovered when artificial respiration was applied. It is best to give the victim the benefit of the doubt.



LEFT: MOTOR TRUCKS RESCUING A CRIPPLED TANK WHICH HAD SLIPPED ITS GEARS WHILE ENGAGED IN A LIBERTY LOAN CAMPAIGN. RIGHT: A FLEET OF 200 BIG TRUCKS AT AMERICAN ARMY HEADQUARTERS, COBLENZ

WHAT THE WAR TAUGHT US ABOUT MOTOR TRUCKS

HOW DESIGN AND CONSTRUCTION FARED IN THE GRUELLING TEST OF WAR SERVICE

BY VICTOR W. PAGE, LATE MAJOR, A. S., A. E. F.

It is not proposed at this late day to outline the important work performed by motor-driven apparatus in the world war. That wonderful work is already a matter of historical record. If anyone supposed that experience obtained through the military use of trucks would result in any radical changes in design or construction, he is mistaken; for the time elapsed since the beginning of the armistice, and the few changes made in the standard trucks that performed such gigantic feats of transport, serve to bring out the fact that the self-propelled vehicle was very well developed even before its use in such quantities by the warring powers.

The conventional two-wheel-drive truck was suitable in the majority of the operations; but this is essentially a vehicle for use where roads exist with a surface that will provide proper traction without too much tractive resistance. The four-wheel-drive trucks were found to be better adapted in those applications where roads were soft or non-existent; and there were even more severe conditions that could be surmounted only by caterpillar-tread tractors. When all means of mechanical transport failed, such as near the trenches, recourse was had to men and mules, large numbers of which were required to mpve relatively small quantities of supplies, the individual capacity being so limited.

The writer was fortunate in having been assigned to engineering work which offered a splendid opportunity to keep in touch with the performance of automobiles used by all branches of the army. The Air Service used motor vehicles exclusively because practically all their work could be done back of the lines, in areas where roads existed, making it possible to use conventional truck designs and trailers to good advantage. The same may be said of the trucks used by the Engineers. The Quartermaster Branch had to transport supplies under all conditions from the base ports to the trenches, and naturally that branch used any means of conveyance that the conditions demanded. The same applies to the Ordnance Department, which also was called upon to function under widely differing conditions that varied from almost ideal to the worst imaginable.

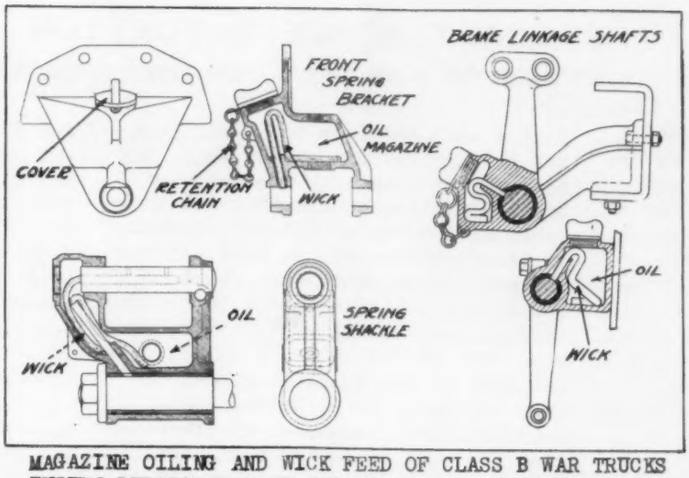
The most favored trucks, of course, were by no means used under normal

AMERICAN MOTOR TRUCKS AT WORK IN FRANCE. THE LEFT HAND VIEW WAS TAKEN IN BREST, THE OTHER IN A VOSGES FOREST

conditions; even those in service at the base ports and supply depots were not given the care that trucks would receive in civilian use. No care was taken in loading, either in the distribution of material on the truck or in the amount carried; and the majority of the drivers handled the trucks in a way that indicated a reckless disregard of life and limb of the bystanders, as well as of the mechanical structure of the truck. The writer has observed trucks overloaded to such a degree that the semi-elliptic springs had flattened out to a point where a decided reverse camber could be seen.

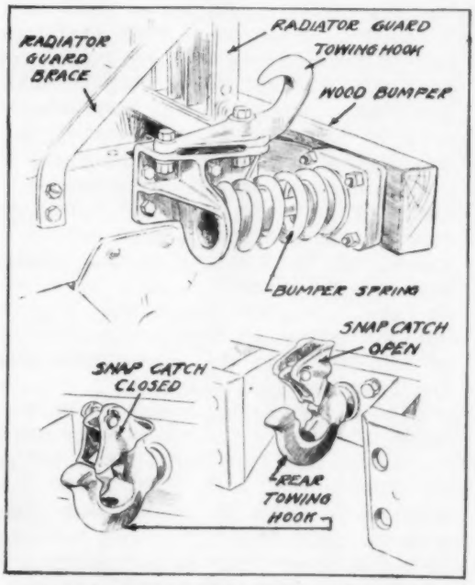
The care of trucks by the authorities and regulations for their garaging when out of use, were not such as to encourage the average driver to take good care of his truck, even in those rare cases where one driver could be held responsible by being assigned to the same truck for several consecutive days. Drivers were shifted from truck to truck and motor vehicles were moved from place to place and from the jurisdiction of one responsible officer to that of another without notice. Owing to lack of building material all trucks were parked out in the open when not in use, and so little shop space was available at most camps that only repairs of damage of the most serious nature could be carried on, and then only to a few trucks at a time. Any adjustments, inspection or lubrication of truck mechanism had to be done in the open; and when one considers that it rains about 200 days per year in sunny France, it will be understood why mechanism depreciated rapidly. One gained the impression that more trucks rusted out than were worn out by useful activities.

When a conscientious driver wanted to oil the parts of the truck chassis that could not be easily reached from the outside, it was necessary to build a platform to raise him out of the mud so he could reach the many grease cups and oil holes which were located at various interior points of the chassis. Water was scarce and trucks could not be washed as often as necessary, so inspection of parts that were coated with baked-on clay mud was somewhat perfunctory in nature, simply for



MAGAZINE OILING AND WICK FEED OF CLASS B WAR TRUCKS INSURE LUBRICATION OF CHASSIS PARTS OFTEN NEGLECTED

the reason that such parts could not be seen beneath their protective coating. It was difficult for a mechanic to tighten nuts and bolts if he could not see them, so any road over which a truck train of any size had passed was usually indicated by a variety of truck parts that had fallen by the way. The loss of a muffler and exhaust pipe assembly was often overlooked by the driver and the truck stopped only if some really essential piece of the mechanism dropped off.



SOME ACCESSORIES FROM THE CLASS B WAR TRUCK THAT COULD BE USED TO ADVANTAGE, ON TRUCKS FOR CIVILIAN USE

Even if motor trucks had been found unsiutable for use under conditions of abuse as already enumerated, it would not have been fair to question their practicability in normal industrial applications. The fact of the matter is, however, the motor vehicle did work efficiently under such trying conditions; and of course such gruelling tests could not fail to disclose some weaknesses of construction. Engineering men who were studying thr work of trucks were often at a loss to know whether certain breakages could be considered a weakness that ought to be corrected, or an inevitable consequence of such conditions of operation.

The tendency of the average driver was to operate his truck at topmost speed, so it was essential that all engines be equipped with some form of constant maximum-speed engine-governor; and great care was necessary on the part of inspectors and supervisory officers to see that such governors were not tampered with. The first move on the part of drivers of a certain class was to "jimmy" the governor so it would not interfere with their speeding proclivities. If an engine failed under such conditions, naturally one could hardly blame the designer or builder, and no lesson was learned that could be usefully applied in future improvements other than an endeavor to design a governor that could not so easily be tampered with.

Owing to operating over soft roads and the use of trucks where no real roads existed, it was found that the low gear ratio of commercial trucks of standard design, which had been applied to war work, was at times not low enough. This fault did not exist to as great a degree on the special Liberty or Class B war truck, which had a lower gear ratio than the usual commercial product. It was definitely decided that four-speed gear boxes were necessary and should always be used on military trucks

MOTOR TRUCK IN USE BY ARMY ENGINEERS FOR ROAD BUILDING

THE DRAFT-HORSE SITUATION

HOW THE GASOLINE TRACTOR AND THE MOTOR VEHICLE HAFE AFFECTED OUR EQUINE STATISTICS

PROFESSIONAL horse-breeders still boost for the business; but they are merely whistling to keep up their courage. Anyone capable of seeing a hole through a ladder must be aware of the fact that the days of the horse as a beast of burden are numbered .

The automobile is taking the place of the carriage horse; the truck is taking the place of the dray horse, and the farm tractor the place of the farm horse.

Nor is there any cause to bemoan this state of affairs. We all admit that the horse is a noble animal, one of the noblest of animals; and that is a very good reason why we should rejoice at his prospective emancipation from a life of servitude and suffering.

That, of course, is the humanitarian side of it; the business side is more to the point; the machine is going to do the hard work of the world much easier and much cheaper than it ever has been done, or ever could be done by horse power.

So here is a chance for great rejoicing rather than a cause for regretting.

In this transformation process not only the horse but the man is going to be relieved of an immense burden.

Let us take a glance at the horse statistics of the United States. They are certainly interesting:

In 1880 the United States had a man population of 50,155,783, and a horse population of 10,357,488, or about one horse to five persons.

In 1890 our man population had increased to 62,947,714, and our horse population to 15,266,244, or a trifle over four men to one horse. In 1900, there were 75,994,575 people and 16, 952,191 horses in the United States; not quite four and a half persons to one horse. In 1910 our population had grown to 91,972,266 and our number of horses to 19,220,338, or not quite five persons to one horse. In 1917, our population was estimated at 100, 000,000, and our quota of horses at 21,126,000, or a little less than one horse to five men.

A comparison of farms and farm horses also becomes interesting in this connection. In 1880 there were 4,088, 907 farms in the United States and on these farms there were 10,357,488 horses, or a little more than two and a half horses to the farm. In 1900, less than three horses were on each of the 5,737,372 farms of that year. In 1910 there were slightly above three horses per farm.

Of course, these figures would indicate that the farm horse at least was holding his own pretty well. But now we must take into account what has taken place within the past three years in the way of the development of the farm tractor. In 1917, it was estimated that there were about 35, 000 farm tractors employed in the United States; in 1918, about 100,000 more were turned out. Now we have the estimate of the probable output of farm tractors in the United States for 1919. This is placed at not less than 314,000. Ninety Thousand of these, it is said, will be exported; the remainder, or 224,000, will be put to work on American farms. Suppose that these farm tractors average 10 horse power, net, each; then we have an aggregate horse power of 2,240,000, which means that that number of farm horses will be put on the permanent retired list. Suppose that there were, say, 150,000 farm tractors in operation in our country at the beginning of the present year, of the same average horse power as above. That would mean that 1,500,000 farm horses had been turned out to grass. Add this number to the tractor power to be turned out this year, and we have 3,740,000, which will represent the number of farm horses put out of commission in the three years ending December 31st, 1919.

But our estimate of average horse power of these tractors is very conservative. The net horse power behind the draw bar of a 40-horse power farm tractor is about 16 horse power. Suppose we split the difference between 10 horse power, our conservative estimate, and 16 horse power, and add half the difference, which is 3, to our original 10. Then we have 13, as the average horse power of the machines already in operation, and those to be turned out during the balance of the year, which would make 4,862, 000, or the real number of farm horses that will have lost their jobs by January 1st, 1920, through the introduction of the farm tractor. Add the number of dray horses displaced by trucks to the number of carriage horses displaced by automobiles, and you will probably have an equal number. This would indicate that by the first of January next, at least fifty per cent of the horses of the three classes named will have been laid off.

Expert horse breeders of draft stock assert that the future of the draft horses in California presents a serious question. Evidently there is a great falling off in the breeding of this class of horses in the State. In 1912, there were 2,034 stallions and jacks registered in California, and on July 1st, 1918, there were but 822 of these two classes of sires registered in the State, a decrease of 65 per cent in six years.

The principal hope of the American draft horse breeders is the prospective demand from Europe, created by war losses. At the beginning of the war, the horse population of the entire world was 95,698,000. Of this number, Russia possessed 24,639,000 horses, or 25 per cent of all the horses in the world. Germany's horses amounted to 4,523,000; Austria Hungary's to 4,374,000; France's to 3, 231,000; Great Britain's to 2,233, 000, and Italy's to 956,000. From these figures may be visualized the tremendous losses in horse flesh resulting from the war, and the draft that will have to be made on the American supply to make them up.

Of course, Europe will introduce the farm tractor. But it cannot depend upon this alone. The farmers of Europe are both impoverished and conservative, and for a series will demand more horses than tractors. Probably American draft horse breeders will have a market in Europe, limited only by Europe's financial ability to purchase and pay for them. The drain upon our horse supply has been enormous for the past two years. On an average of about 50,000 horses per month have been shipped to Europe to supply the needs of the Allied armies. In California, every horse available for Army use has been sold, and still there is a demand for more. These horses sold at from $800 to $1,000 per head.

A GRAIN HARVESTER AND STACKER COMBINED

For use where the header is frequently employed to harvest grain, a combined harvester and stacker has been devised. Grain from the header is delivered into a large bin; and as it reaches this box it is placed by an operator much as bound bundles would be placed in a stack. When filled, a rope passing around this "stack" is securely fastened to the ground at both ends. The rear end of the box being hinged at the bottom is lowered to the ground, and as the header is drawn forward the stack is slipped out and deposited on the ground.

The operators plan to drop these stacks in groups of three or more each, so that threshers can move over the field, making a set for each group of stacks. It is hoped to cut the cost of stacking in half.

AMERICA S AUTOMOBILE INDUSTRY

SOME FACTS AND FIGURES WHICH INDICATE ITS MAGNITUDE

THE importance of the automobile industry to the prosperity of the country and of the automobile and motor truck to the daily needs of the American public is shown by the amount of capital invested and the great sums of money kept in active circulation by purchase of materials and payment of wages; the hundreds of thousands of persons dependent entirely upon the industry for a livelihood for their families and themselves, and the increased wealth brought to American workingmen and investors by the exportation of American motor vehicles and parts.

That the American public appreciates the utility of the motor car and considers it a necessity is revealed by the surprising number in use, amounting to more than 5,000,000 at the end of 1917, which is the last year for which accurate statistics are available. From two to three times as many automobiles in proportion to population are owned in the Central and Western States as in the manufacturing States of the East, indicating that the farmer who needs transportation most appreciates the facilities for quick and convenient transportation supplied by the motor car.

It is significant of the importance of the motor car to the industry and commerce of the country that in the railroad freight congestion in 1917 the 435,000 trucks in use hauled about 1,200,000,000 tons of materials during the year. And in view of the demand for increased production of foods, it is highly important that 10,000,000 acres of land were released by the use of motor trucks instead of horses, which require five acres of land each for their support.

According to the National Automobile Chamber of Commerce, whose facts and figures are the basis of this article, there are 550 motor vehicle manufacturers in the United States. Of the commercial vehicle manufacturers, there are 372, and of the passenger vehicle manufacturers, 238, some manufacturers building both commercial and passenger cars. The automobile and motor truck factories are located in 32 States, while the capital invested in the industry sums up to $736,000,000, giving employment to 280,000 persons.

The figures compiled up to June 30, 1917, indicate that 1,878,878 motor vehicles were produced in that fiscal year, of which total 1,718,778 were passenger cars and 160,100 commercial cars. The average retail price of passenger cars produced during that period was $727.00.

Turning to the automobile parts manufacturers, we find that there are 6,789 concerns engaged in producing some article used in the automobile trade. In automobile tires alone, the

(Continued on page 520)

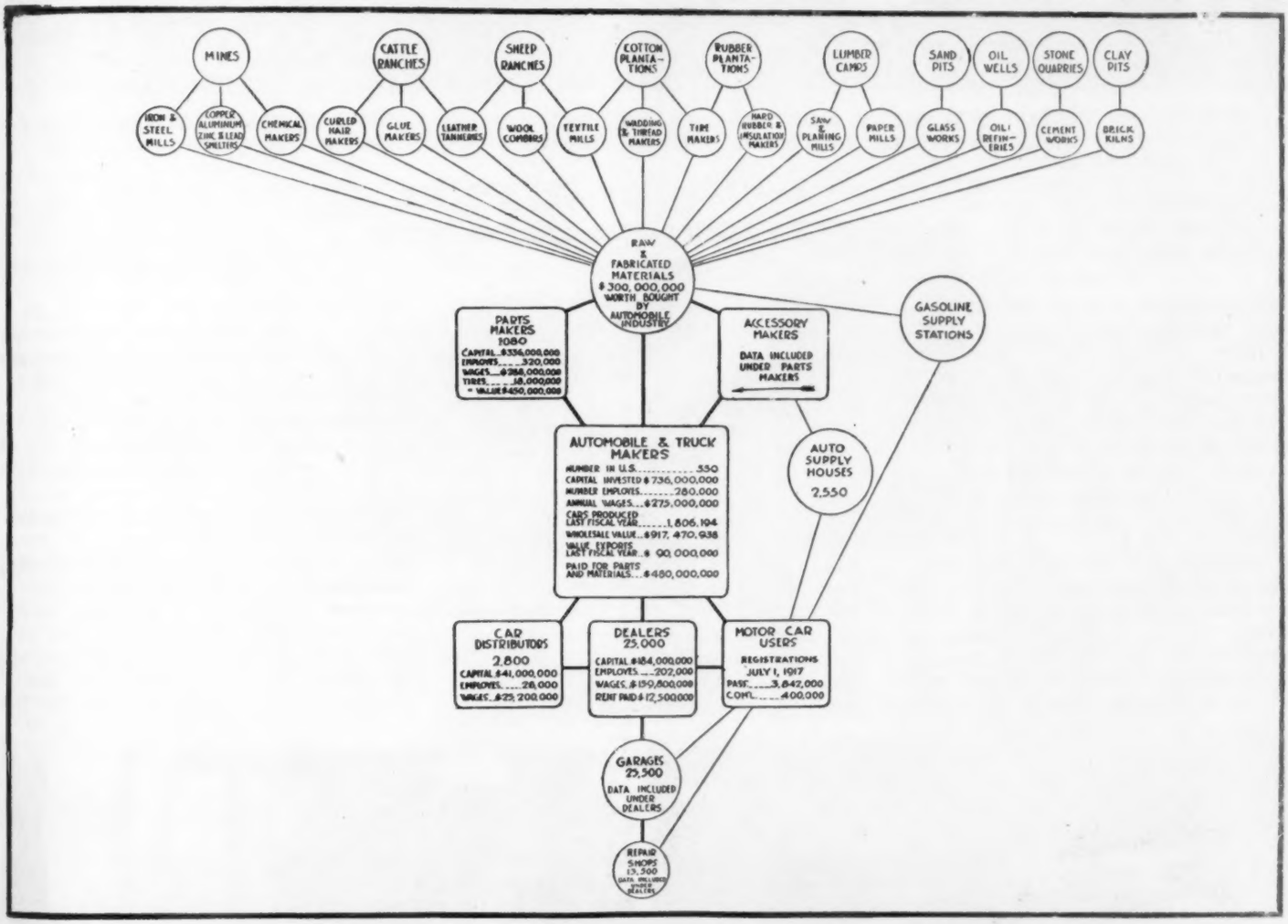
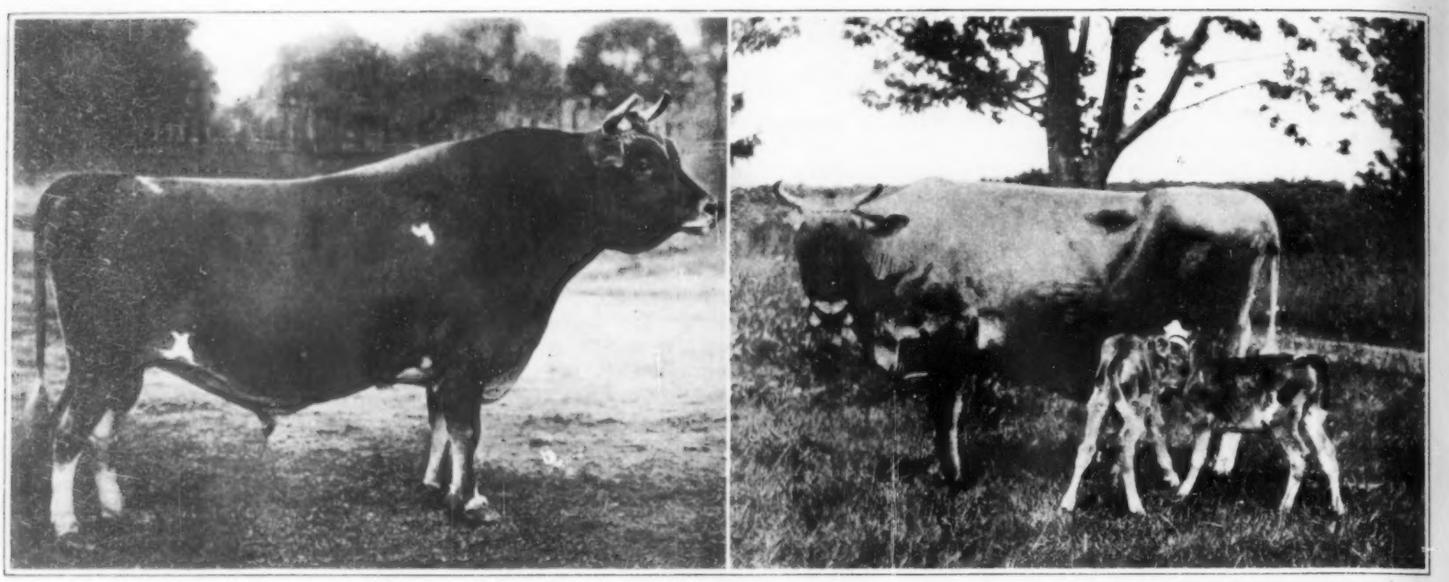


CHART SHOWING SOURCES OF SUPPLY AND SYSTEM OF DISTRIBUTION IN THE MOTOR-CAR INDUSTRY, WITH CAPITAL INVESTED, LABOR EMPLOYED, WAGES PAID, VALUE OF PRODUCT, ETC.



AT THE LEFT: THE SIRE OF A LEADING DAIRY-FARM HERD. AT THE RIGHT: ONE OF THE COWS, WHO IN FIFTEEN MONTHS HAS HAD THREE CALVES AND PRODUCED IN A 365-DAY TEST 11,728 POUNDS OF MILK TESTING 6-32 PERCENT BUTTER FAT

THE HIGH PRICE OF MILK

SOME OF THE CAUSES, AND THE REMEDY

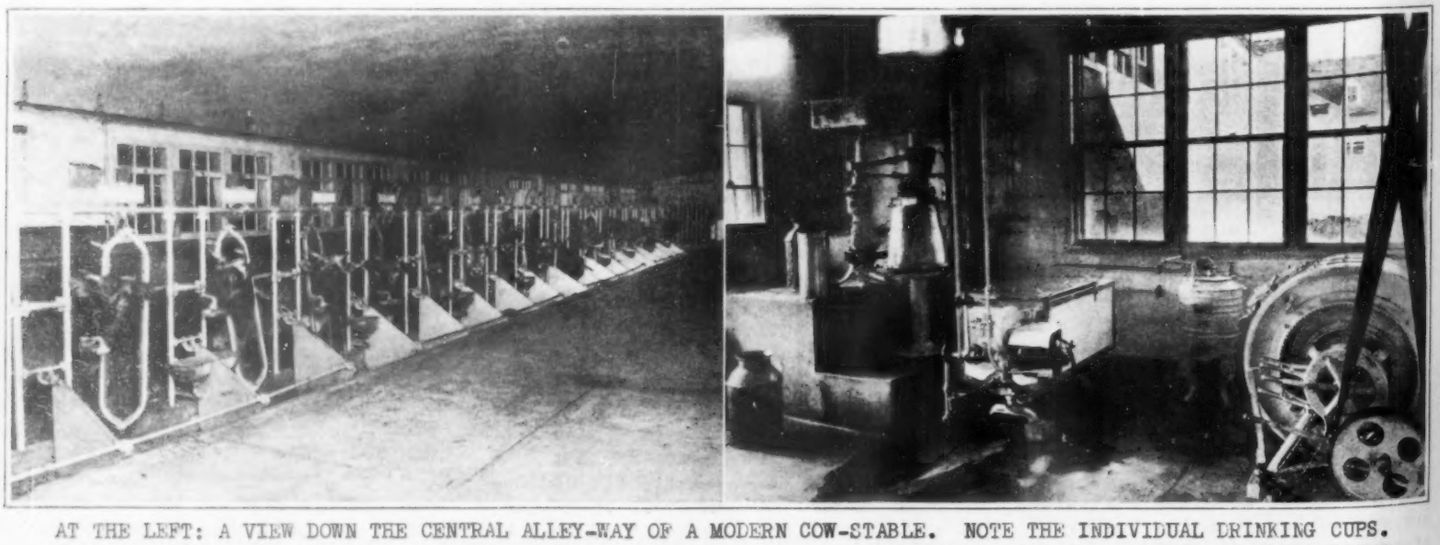
BY ALFRED J. LOTKA

Fifty million dollars wasted annually, and you are footing the bill! At least, you contribute your quota; though you may not know it. How? By paying board for seven million cows that fail to justify their existence.

There is no magic about it; it is all very simple. A farmer has a herd of twenty cows, say. He feeds them all from a common supply, gaging by eye the portion for each cow. He collects all the milk from the herd in a common container. If the herd, thus averaged, yields a reasonable profit, he is satisfied. Among his cows may be one or two exceptional producers; there are probably also several "boarders" - hearty eaters but poor milkers. He of course knows that some of his cows are better than others; but unless he keeps track for each cow individually of the food consumed and the milk produced, he cannot know that some of his herd are simply eating up dollars, so that he would be better off if he sold them and kept his business going with a smaller herd.

Meanwhile the farmer goes on struggling against heavy odds; weighted down with the drudgery of his daily round, he cannot find time and energy to turn from the more insistent and indispensable tasks to attent to the fine points. And so the thing goes on in a vicious circle. Because his methods are imperfect the farmer is overburdened. And because he is overburdened he cannot find the time to correct his methods. Indeed, during a recent period of excessively high prices for feed, so many farmers were selling out their cows, being unable to make ends meet, that the Government became alarmed.

The first step toward improving the situation is simple enough. It consists in keeping a book for each cow, individually, of the value of food consumed and the milk and milk products returned. Such records are capable of four-fold use. They furnish the basis for an accurate cost and profit account. They show up the cow



AT THE LEFT: A VIEW DOWN THE CENTRAL ALLEY-WAY OF A MODERN COW-STABLE. NOTE THE INDIVIDUAL DRINKING CUPS. WHEN THE COW WANTS TO DRINK SHE RAISES THE LID WITH HER NOSE. AT THE RIGHT: THE CREAMERY IN A MODERN DAIRY

that should be sold for beef. They may bring out unsuspected virtues in some other individual, and give information of value in directing the breeding of the herd. And they will guide the farmer in setting a proper valuation and sale figure on his animals.

Figures from actual sales will illustrate this point. At one sale 19 cows, all on the official Register of Merit, brought an average price of $303. At another, 19 cows without test record averaged $145. At a third, where no animals claiming any connection with the Register were offered, the cows averaged $78.

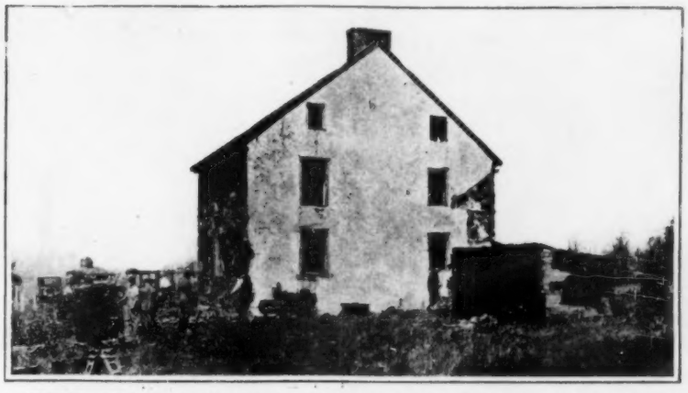
Evidence of another kind pointing in the same direction is the sale of exceptional animals at a low figure because owners were unaware of their qualities. Rochette's Golden Princess, a Jersey cow who has since attained a record of 15,286 pounds of milk and 753 pounds of butter fat in a year, was purchased for $135. Vive la France, holder of world's record for one year's butter fat production by a Jersey cow - 1029 pounds - is out of a cow that was never tested officially, and by a bull purchased for $150 at seven years. When we contrast this with the $10,000 paid for Oxford's Briar Flower, a cow; the $25,000 for Golden Fern's Noble, a bull; and the $30,000 paid for a half interest in Financial Sensation, another bull, we see what a stroke of luck such an animal as Rochette's Golden Princess represents to its purchaser, and what losses may be suffered by a seller through neglect of tests.

(Continued on page 523)

DYNAMITE AS A HOUSE WRECKER

With the existing shortage of labor, the usual method of house-wrecking is somewhat a costly operation -- so costly in fact, that the salvaged material is often not equal to the expense involved. So it has come to pass that the simplest way of house-wrecking is to blow up the house; and the better the blast, the less will be the work of cleaning up.

A case in point was that of a three-story stonehouse that stood upon a farm down in Delaware. It has passed its usefulness and the owner wanted to remove it. The problem was to raze it as cheaply as possible and, at the same time, to reduce to a minimum the work of collecting the resulting debris.



A THREE-STORY FARMHOUSE OF STONE AND HEAVY LUMBER WHICH HAD TO BE REMOVED WITH MINIMUM LABOR AND EXPENSE

Dynamite was decided upon as the means of accomplishing this. There was no doubt that dynamite would destroy the house. The difficulty was to get the walls to cave in instead of scattering over a 20-acre field.

After a careful study it was decided to place dynamite charges along three sides of the house, with none whatever along the fourth, which was not solid stone but partly of timber. So three holes about four feet deep were put down upon the two short sides of the house, and four along the one long side. The bottom of each hole was about one foot from the foundation. These holes were now sprung, or chambered by exploding a small charge of dynamite in the bottom of each, making cavities large enough to hold several pounds of dynamite. In each of these sprung holes was placed a charge, of from eight to twelve pounds of dynamite.

After making the necessary electrical connections the audience and operatives retired to a safe distance. Following the blast and the clearing away of the smoke and dust, it was seen that the dynamite had performed its work so perfectly that fully 95 per cent of the wreckage lay in one pile. The roof had dropped exactly over the cellar, and the four walls had caved in from all sides to the center, exactly as it had been calculated that it would do.

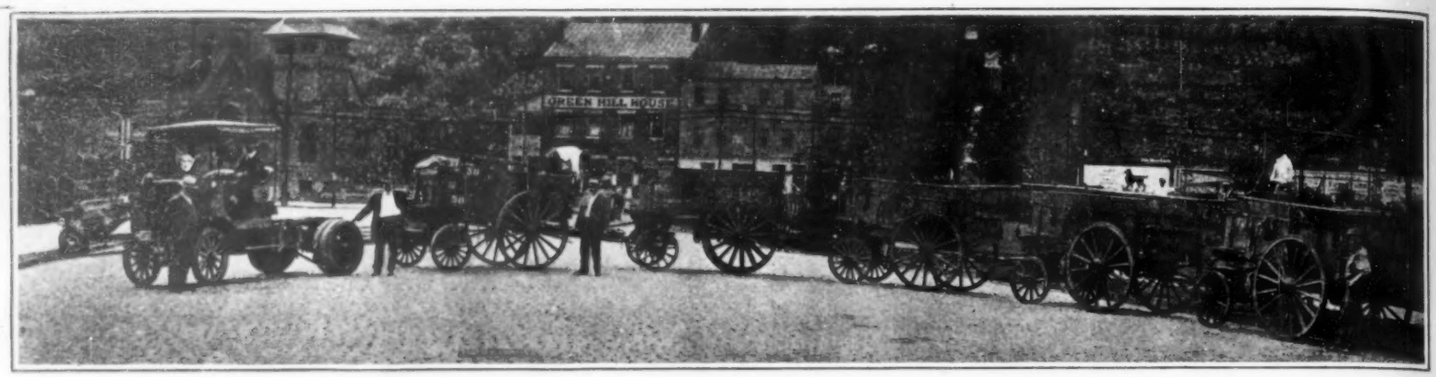
AFTER THE DYNAMITE BLAST THAT ACTED AS WRECKING AGENT. ABOUT 95 PER CENT OF THE WRECKAGE LAY IN ONE PILE

MOUNTAIN CLIMBING - A PEACETIME USE FOR "TANKS"

France's task of beating swords into ploughshares included the conversion of tanks into something having peacetime value. Some have been employed for towing canal barges; others have become agricultural tractors; others have made their way into the factory, where they carry loads from place to place. But the most novel conversion is no doubt that of the mountain-climbing tanks, now available to tourists of the French Alps of Savoy.

Shorn of its coat of armor and its fighting equipment, the tank boils down to a very powerful caterpillar tractor. Provided with seats so arranged as to get the most seating capacity out of a given floor space, it becomes an excellent passenger-carrying vehicle for traversing rough terrain. Indeed, in the mountain-climbing service the tanks are called upon to cross small brooks, uneven ground, boulders, logs, brush, tall grass, and so on, not to speak of the steepest rises. Our cover illustration offers some idea of the thrills of a ride in the mountain-climbing tank.

TOURING THE FRENCH ALPS IN A CONVERTED TANK



TRAIN OF TRAILERS MAKING COMPLETE TURN, WITH ROOM TO SPARE, IN A MODERATELY BROAD STREET

THE GASOLINE LOCOMOTIVE OF THE HIGHWAYS

SPECIAL TRUCK MODELS FOR USE AS ROAD TRACTORS WITH SEMI-TRAILERS

BY HARRY WILKIN PERRY

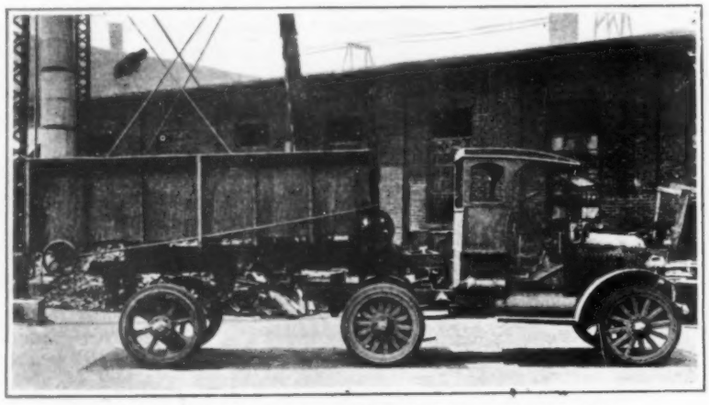
Motor truck manufacturers whose engineers have made a study of the economics of haulage have found, within the last few years, that the semi-trailer and trailer are so satisfactory and economical in many kinds of work that, under appropriate conditions, they not only recommend their use to purchasers of trucks, but are offering as part of their regular lines, tractors designed especially for hauling trailers.

These tractors are characterized by very short wheel-base, reinforced frame, heavy rear axle, springs and wheels, 4-speed gear-shift, reduced gear ratios, and built-in fifth-wheel or other connection for the trailers. Such tractors are intended primarily for use with semi-trailers, the front ends of which rest on the fifth wheels built into the frame above the rear axle of the truck. The rear end of the truck carries about half of the load; the rest comes on the axle of the trailer. A tractor with the load divided in this way hauls from two to three times as heavy a load as an ordinary truck of similar power and construction. The tractor has no body and carries no load save that on the trailer.

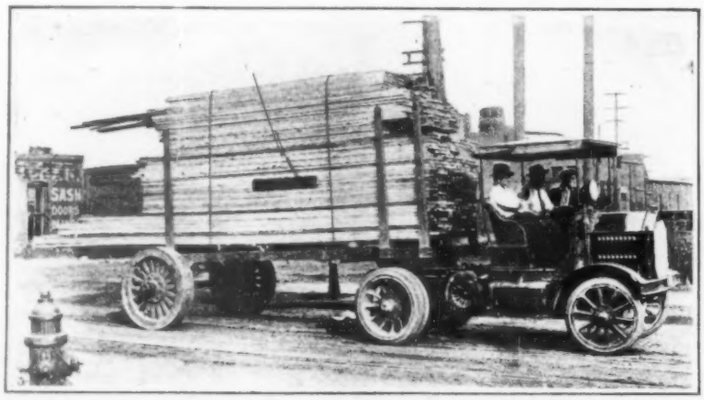
Several good examples of such tractors are illustrated. One company has for some time furnished 7, 11, and 15-ton tractors as part of its regular line of trucks. Recently it added a 5-ton, chain-drive tractor, designed especially for hauling trailers of this maximum capacity. These are in general similar to the regular 2 to 7 ton chain-drive trucks, but they have a wheel-base of only 119 inches and heavier rear springs. A fifth-wheel is provided for the rear end of the frame, where it is bolted, and the upper plate has a universal action of rotation about three axes, which allows the trailer to accomodate itself to all irregularities of the road and to make short turns without causing any twisting strains in the frame of the tractor or the trailer. Stiff helical springs support the circular plates of the fifth-wheel with their load, thus cushioning the shocks of the load on the tractor frame. The rear wheels run from 36 x 4 to 40 x 7 solid tires in passing from the smallest to the largest model. The engine of the 5-tpn tractor is 25.6 horse-power, and of the larger sizes 40 horse-power. The transmission has four speed changes in all models The turning radius of all is 21 feet

For many forms of work this tractor used with semi-trailers may be taken to afford the most efficient means of utilizing the power developed. Greater efficiency in tonnage hauling and low ton-mile cost are gained by the use of trailers. The tractor need never remain idle. The semi-trailers can be detached for loading or unloading, the tractor being ready for the attachment of another vehicle at once. Different types of semi-trailer can be used with the same tractor, provided they are equipped to take the fifth-wheel. This connection works equally well with short semi-trailers having high center of gravity, and with long semi-traulers such as are used for lumber and structural steel haulage.

One of the best known makers of trucks has for the past three years been manufacturing tractors in 2 and 5-ton sizes for hauling trailers and semi-trailers. For use with semi-trailers they are fitted with rocking fifth-wheels; for use with four-wheeled trailers they are provided with a



TWO-TON TRACTOR, WITH DUMP-BODY SEMI-TRAILER USED IN INDIANAPOLIS FOR HAULING OF BULK METAL



HEAVY-DUTY TRACTOR AND SEMI-TRAILER. NOTE STEEL WHEELS OF TRACTOR, AND ROLLERS BENEATH LOAD TO AID IN HANDLING

spring-type pintle hook that takes up the shock incidental to starting the loaded trailer. The gear in the 2-ton model has four forward speeds, and in the 5-ton model, three. Believing it safer to run at low speed with trailers, this company gears the tractors to operate at 11½ miles per hour in high. Frames and spring structure are made stronger than in the regular truck models, and the wheel base is of course considerably shorter. This company does not recommend the use of trailers with its regular models, preferring that customers use the tractor chassis for tractor work; and it is preparing to push this model more vigorously.

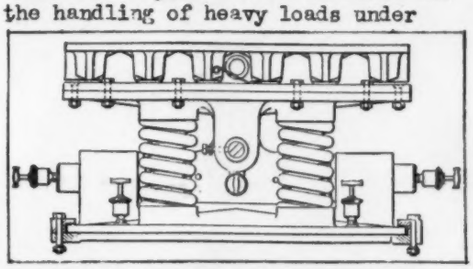
A New York meat packer is operating one of these 5-ton tractors with a specially built semi-trailer of 12 tons capacity. He finds that the outfit, with one driver and one helper, does the work of three single trucks and at no greater expense. The tractor and trailer had been driven more than 16,000 miles when this report was made up, the daily average being 28½ miles and the trip tonnage averaging 12¼. For one month the operating cost, including driver and helper, tires, repairs, insurance, interest, depreciation, tax and licence, was $16.48 per day, the cost per mile 58 cents, and the cost per ton-mile slightly less than five cents.

The tendency on the part of the buying public, together with its own belief that the use of trailers results in more economy than the use alone of trucks, led one of the largest exclusive manufacturers of trucks to design a tractor which is now in regular production. It is of 6-ton capacity and is used both in connection with semi-trailers and 4-wheeled trailers. It has a shorter wheel base than the company's regular truck models.

The engineering department here consults with propsective purchasers, analyzing their particular hauling problems and recommending the equipment believed best suited for their work. This company observes that "the last year seemingly has been a period in which the transportation people of the nation have, with almost one accord, come to realize that, through the use of suitable trailers, the earnings of the motor truck are doubled and in some cases more than doubled."

A big Ohio truck maker regularly catalogs three tractor models, in 4½, 7, and 10-ton capacities. They have, respectively, 116, 105 and 102 inch wheel-bases and range in horsepower from 29 to 41½; they have four forward speeds, reinforced frames, and wheels of very heavy wood or of metal. The two larger sizes are provided with permanent cab, with side curtains and windshield.

Regarding these tractors, the manufacturers say that each is built for the handling of heavy loads under



SECTION SHOWING CONSTRUCTION OF A TYPICAL FIFTH WHEEL, WITH UNIVERSAL ACTION AND SPRINGS SUPPORTING THE LOAD

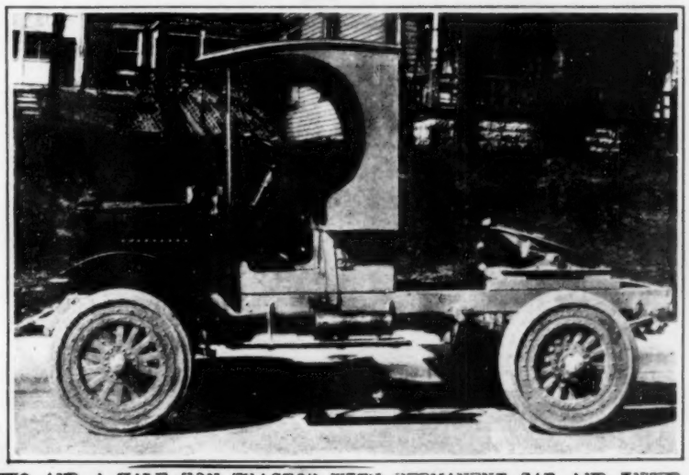
conditions where tractors may be successfully operated but where in many instances motor trucks could not be profitably maintained. The tractor field, while limited, has made possible the use of motorized hauling equipment in many places where standard vehicles could not be considered.

To Massachusetts belongs the distinction of being the home state of the pioneer truck maker, who is also the pioneer maker of road tractors. About eight years ago this concern brought out a three-wheeled tractor designed for hauling semi-trailers; and a considerable number were sold and used extensively. Since then it has changed to the four-wheeled type and for several years this has been its main product, together with the accompanying trailers, semi-trailers and haulage accessories. It puts out an interesting "traction unit," consisting of a heavy axle, wheels, springs, and platform with fifth wheel, together with differential and driving mechanism. By removal of the corresponding parts of a touring car or runabout and substitution of this traction unit, the passenger automobile is converted into a tractor for hauling semi-trailers of 2, 3, or 5 tons capacity.

This company's regular tractors are made in capacities up to 10 tons. The latest addition to the line is a special model for heavy work over rough roads, on bad ground, and up grades that would bar the use of the motor truck. In design it resembles a farm tractor, and has either rubber-tired or heavy cast-steel-ribbed wheels, making it especially suitable for hauling tarins of dumptrailers, for road construction work, and for use in logging, excavating, dam building, on plantations, etc. It is able to pull from five to ten times as much load on trailers as a conventional motor truck can carry. The tractor is provided woth a differential lock and patented hydraulic brakes operating on the power axle in addition to the jack-shaft brakes.

This tractor also has a power winch mounted on the rear end of the frame, which exerts a draw-bar pull of ten tons through a cable that winds up on the drum. With the engine running at 1,000 RPM this cable is hauled 40 feet per minute. By it the tractor can pull itself and one or more loaded trailers up the steepest grade or out of any hole. The winch is also used for drawing logs, hoisting heavy machinery, moving or wrecking houses, and a variety of other purposes.

Tractors of several sizes with four forward changes of speed and mounted fifth wheel are made by an Indiana truck company. The fifth wheel is of the spring type 24 inches in diameter in small tractors and 30 in larger ones. This company has made a thorough investigation of the practicability of the use of trailers in connection with its trucks, and is preparing this data in the form of a loose-leaf folder which will soon be in the hands of its dealers and salesmen. It is prepared to recommend advantageous methods of hauling to prospective truck purchasers.



TWO-AND-A-HALF TON TRACTOR WITH PERMANENT CAB AND INTERESTING FIFTH WHEEL, WITH SPRINGS FOR COMPENSATING PULL AND THRUST OF TRAILER

(Continued on page 522)

PLOWING DEEPER AND DEEPER

THE GASOLINE TRACTOR AND THE SCIENCE OF SUB-SOILING

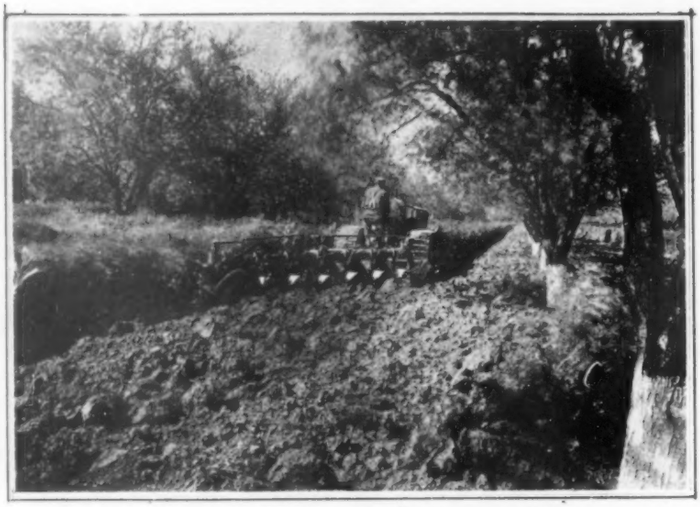
BY H. A. CRAFTS

For added increase of food products, the country must look undergroung not abroad. All the choice agricultural lands have been taken up by the settler, and immense areas have been exploited to the limit.

Take the wheat lands of California for an instance. Back in the 70's, this was the leading wheat-producing state of the Union. The new lands produced large yields but, on account of poor and shallow plowing and continuous cropping from the land without rotation or re-fertilization, the average per acre yield throughout the state had fallen, in 1898, to 9.1 bushels. But there is a decided prospect of better things, and this by reason of the advent of the gas farm tractor, an instrument that seems to deal conclusively with the crop problem.

First the bare fact of deeper plowing. A plow which goes down into the soil to the depth of ten or twelve inches, where never before a plow penetrated beyond five inches, virtually brings to the surface a new farm, a farm of virgin soil.

This is the kind of plowing that is being done in California today under the introduction of the farm tractor



A HEAVY JOB OF ORCHARD SUB-SOILING

The tractor not merely delivers this new farm to the farmer; it cuts the cost of plowing in less than half.

And after deep plowing comes an almost equally important factor - that of sub-soiling.

In California there are three principal conditions which render sub-soiling of vital importance. These are: natural conditions consequent upon soil fermentation, a plow sole, and an irrigation sole.

Many of the agricultural lands are of stubborn nature by reason of volcanic composition of soil. Such conditions are quickly subdued by the farm tractor and its deeper plowing.

But beneath all of the old wheat lands there exists an old plow sole, in process of formation for more than fifty years. Because California plowing under horse power never reached a depth greater than five inches, while many fields were broken up only three inches deep, we find a tremendous hard-pan crust when we penetrate to that depth. Year after year the plow has compacted the soil down to the same old level.

So thick and compact have these plow soles now become that tractor farmers find it impossible to plow them up all at once, for the reason that they would make the surface so lumpy as to be difficult of cultivation. Consequently they penetrate the plow sole by degrees, setting the plow points say an inch deeper in each successive plowing. But much more effective methods are being introduced just as rapidly as the necessary machinery can be turned out of the factories.

This machinery consists of different types of sub-soil plows; sub-soiling is becoming one of the standard processes of modern farming.

(Continued on page 525)

SUB-PLOWING WITH ONE TRACTOR PULLING THREE 14-INCH PLOWS

TRUCKS THAT FIGHT FOR BUSINESS

The motor truck is more than a carrier.

THE Motor Truck is an aggressively constructive commercial force.

The Motor Truck untiringly fights for business. It can be advantageously adapted to every class of haulage. It opens up new fields of demand. It taps sources of supply quickly and directly. It is a strong offensive against competition. Its speed and capacity, tremendous strength, and power of performance conveys to the public a sense of dependable prestige.

SERVICE Trucks fight for business.

The Service Oil Company, Fairmount, Indiana, started business in March, 1918, with a 1½-ton SERVICE Truck. The uniformly efficient and dependable performance which they secured from their SERVICE Truck, enabled them to fight for business in the face of strongly intrenched competition. Today they operate four SERVICE Trucks and their business has increased from 1500 gallons a day to 12,000 gallons a day.

SERVICE Trucks will aggressively build YOUR business.

SERVICE Motor Trucks are so designed and so constructed that in their performance they are delivering constructive, Business Building transportation.

Thousands of manufacturers, jobbers, merchants and farmers have profited by the ability of SERVICE Motor Trucks to *fight* for business. They tell their stories in the following composite paragraph.

This composite endorsement was written by the following SERVICE owners:
W. J. Newman Co., Chicago; A. McGee, Cincinnati; Advance Transfer Co., Kansas City.

"The SERVICE Truck has exceeded our highest expectations. It is taking care of all its loads and grades without difficulty. We have never regretted buying a SERVICE Truck. We recommend them without the slightest hesitation."

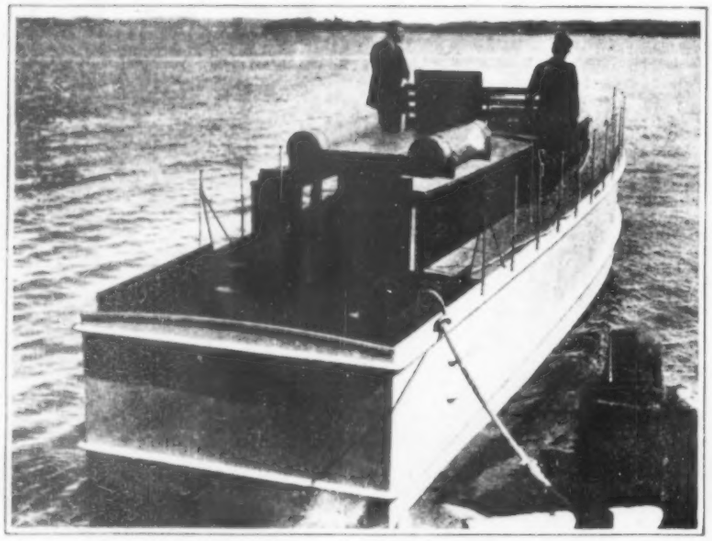
These users know what SERVICE performance means. They have experienced the satisfaction of growth in business, with SERVICE Trucks a vital contributing force.

Service

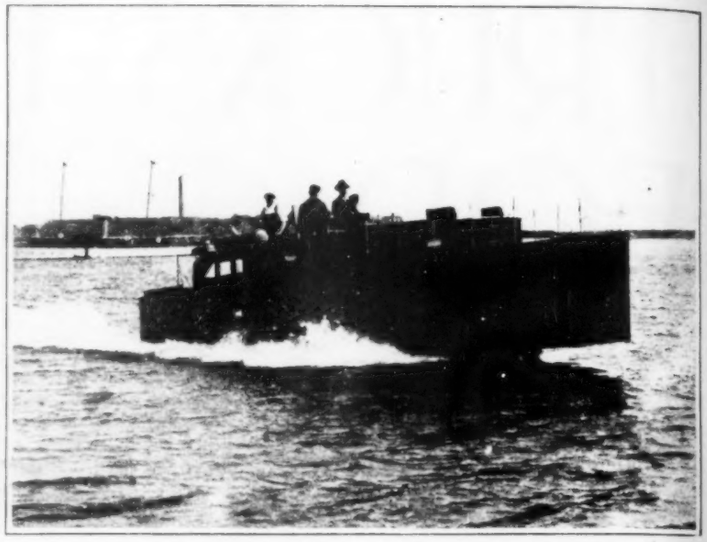
MOTOR TRUCKS

Builders of Business

SERVICE MOTOR TRUCK CO. Wabash. Indiana. U. S. A.



LIGHT, DIAGONALLY-PLANKED CRUISING HYDROPLANE MOTOR BOAT, BUILT FOR SOUTHERN WATERS

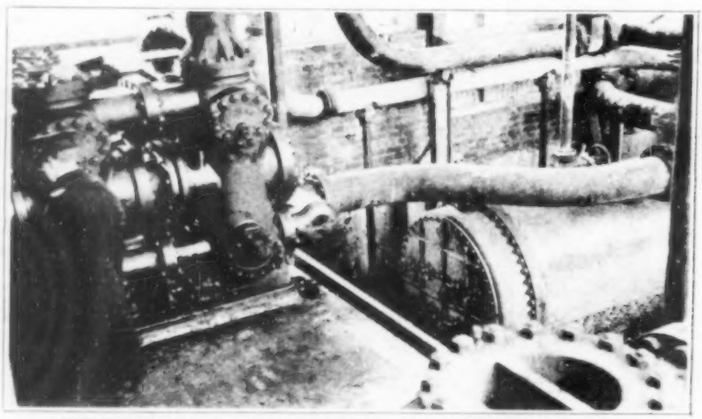


THE NOVEL WEDGE-SHAPED CRAFT MAKING 25 MILES AN HOUR ON LONG ISLAND SOUND

FAST BOAT FOR SHOAL WATERS

The unusual form and appearance of the fast motor boat here shown are explained by the character of the service for which she was designed. Her owner wanted a boat of moderate size, roomy accomodations and high speed for cruising in southern waters, and particularly in the Savannah estuary and river, where there are bad sandbars and shoals which prevent any but the shoalest boats from navigating at all stages.

The dimensions are: length 45 feet, beam 8¼ feet; and draft when under way only six inches at the stern. The motive power consists of two 100-horse-power, 4-cylinder, 4-cycle, Van Blerck engines. The fuel supply of 150 gallons is carried in two gasoline tanks in the after part of the boat. There is a 6 x 8 foot cabin forward and a main cabin 6 x 12 aft; and there are accomodations for 8 sleepers. The boat was built by B. F. Wood of City Island from designs by C. N. Andrade, Jr., and every effort was made to cut down weight and produce a boat fast and capable on a relatively low displacement. The bottom is diagonally triple-planked with a total thickness of about two inches; and the sides are diagonally double-planked, with a thickness of 1 5/8 inch. The framing is 1½ inch, and the whole vessel is secured with copper rivets and brass screws. The bottom is slightly rounded, with a six-inch rise. Freeboard is 4 feet.



INTERIOR VIEW OF A PUMPING AND HEATING STATION ON THE AMERICAN PIPE-LINE THROUGH SCOTLAND

A PIPE-LINE ACROSS SCOTLAND

One of the notable achievements of the United States Navy during the war was the construction of a pipe-line across Scotland from the Clyde to the Firth of Forth, for the purpose of supplying fuel oil to the British naval base at Rosyth, above the Forth bridge.

The line, 36 miles long, extends from Old Kilpatrick on the Clyde, 10 miles below Glasgow, to Grangemouth on the Forth, and generally follows the line of the Forth Canal. There are three stations on the line; at Old Kilpatrick, Hungrysite and Castlecary; and a terminal at Grangemouth, where the oil is stored and loaded into boats. The stations are equipped with Babcock and Wilcox boilers, high-pressure pumps, and oil heaters, similar to those used in California and Mexico for handling the heavy local oils. The line is an 8-inch pipe of steel and the pumps are capable of operating under a pressure of 300 pounds per square inch.

Anyone who has seen the crude oils and is familiar with their viscous character can understand that in a

(Continued on page 521)

TWO VIEWS SHOWING THE LAYING OF THE AMERICAN PIPE-LINE ACROSS SCOTLAND, AND A THIRD OF ONE OF THE PUMPING STATIONS

"WE kept cost records of standard makes of truck tires and as a result adopted Goodyear Solid Tires for all our 12 trucks. Our experience with them dates from 1915, and has been decidedly gratifying, mileages always averaging at least 15,000 and running up to 33,000."—Burton Phinney, Purchasing Agent, City Fuel Co., Boston

WHEN the first Goodyear Solid Tire ever used by the City Fuel Company of Boston ran 29,000 miles, officials began a comparative test with different makes.

In due time it was observed that, while the greatest individual mileage obtained from other tires had been 12,000, all the Goodyear mileages averaged 25 per cent higher.

Indeed, it was observed and recorded that all the Goodyear Solid Tires on the trucks carrying the heaviest burdens averaged above 20,000 miles per tire.

Subjected to conditions such as most quickly grind the miles out of tough rubber compounds, these tires had demonstrated the superiority of their treads.

Punished constantly by strains such as sometimes wrench solid tires loose from steel bases, these had proved the massive strength of their whole construction.

Now, the major result of the City Fuel Company's experience, totaling millions of tire miles, is noted in the fact that every wheel of every truck is Goodyear-shod.

In indicating another factor in this result, the company points to important attention received from a local Goodyear Truck Tire Service Station, one of hundreds serving truck owners everywhere throughout the country.

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

GOODYEAR

AKRON

AMERICA'S AUTOMOBILE INDUSTRY

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output for the fiscal year ending in 1917 amounted to 18,000,000, representing a value of $450,000,000.

The dealers, garages, repair shops, and so on aggregate 46,000, of which 27,8000 are automobile and truck dealers, and 25,500 are garages. The automobile repair shops number 13,500. Estimating the capital invested by dealers, garage owners, and so on, at $4,000 each, the aggregate here reaches $184,000,000, while if we assume the number of workers employed per establishment to average five, this brings the number of workers to 230,000.

The United States is the largest manufacturer and exporter of motor vehicles in the world. For the fiscal year ending in 1917, something like $135,750,000 worth of automobiles, trucks, tires and parts were exported. There were in this total 64,448 passenger cars, valued at $51,800,000. There were 14,866 commercial cars, of $37,820,000 valuation. Engines, tires and other parts amounted to $46,129,000.

On January 1st, 1918, there were 5,148,000 motor vehicles registered in the United States. Of motor trucks alone there were 435,000. It is estimated that the motor trucks of this country haul 1,200,000,000 tons of goods a year; and the cost of this haulage, based on a standard figure of 18 cents per ton-mile, would work out at $1,080,000,000, as compared with the cost of doing the same work on a basis of 24 cents per ton mile by horse and wagon, amounting to $1,440,000,000.

There are 21 persons in the United States to one motor car. In eleven middle western states there is one automobile to every 17 persons; in eleven eastern states, one car to every 26 persons. The percentage of cars sold to farmers in 1917 is estimated as 40 per cent of the total year's output. When we realize the full magnitude of these figures, we cannot help but acknowledge the big part which the motor-driven vehicle plays in the national life and the national prosperity.

WHAT THE WAR TAUGHT US ABOUT MOTOR TRUCKS

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except the lightest vehicles. The form where the direct drive is ovtained on third speed, with a geared-up fourth, is best in the writer's opinion, because most of the driving will be done on third speed anyway if road conditions are not of the best.

The chassis frame-construction of many of the standard pre-war trucks was not strong enough, and many were severely strained by towing trailers, worj for which the trucks were not prinarily designed, but which was highly necessary in certain services. The frame of the standard military truck must he exceptionally strong and be provided with special reinforced front towing hooks and a spring draw-bar hook at the rear. These features of the Class B truck, as well as the strong spring-backed bumper of wood and the radiator guard, could be incorporated to advantage in commercial truck design.

The best type of radiator was found to be that using finned tubes with cast bottom and top headers and sides. The capacity of the conventional truck radiator was not sufficient, nor were the fans and belts adewuate to provide positive cooling under all conditions. This is a feature that is often neglected on commercial products and a useful lesson can be learned from the experience of operators of military trucks. The radiator should have large passages, good capacity and an exceptionally strong frame. The water connections should be large and simple in design. The fan bearings should be of

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A PIPE LINE ACROSS SCOTLAND

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length of 36 miles the total amount of friction, due to the flow of the oil, would rise to large figures. Consequently it is not only necessary to force the oil through the pipe under high pressure, but the oil must also be heated to render it more fluid. This is done by passing the exhaust steam from the pump engines into tanks through which the heavy oil passes on its way to the pipe line.

It was in October 1917 that Sir Frederick W. Black, of the British War Mission, suggested the construction of a pipe-line for transporting fuel across England and Scotland so as to avoid sending the tank steamers through the submarine-infested waters of the North Sea; and shortly thereafter Mr. A.C. Bedford and Mr. Forrest N. Towl, C. E., left for London, where after a discussion with Admiral Sims and British naval authotities, it was decided to make a careful inspection of the proposed route.

The ditching of the line and the building of the stations with their equipment was done by the British. On Mr. Towl's return to the United States the Navy authprized him to recruit a special Pipe-Line Unit for the purpose of building the line. The Unit was in charge of Lieut. Commander W. A. Barstow, and included algogether 119 men. The 36 miles of 8-inch pipe, weighing some 3500 tons, left Philadelphia on June 13th on the S. S. "City of Glasgow;" and the men commenced work in Scotland on July 11th, The laying of the line was practically completed on September 11th, 1918.

The line consists of 9256 joints of pipe corrected by 13 flanges, and in these there are 1082 bends. The pipe was buried about three feet deep in the canal bank the course of which was very closely followed. The whole enterprise reflects great credit on those who put in through in such a short time.

THE GASOLINE LOCOMOTIVE OF THE HIGHWAYS

(Continued from page 515)

At present a Milwaukee company is manufacturing tractors in its 2½-ton size, with either 110 or 130 inch wheelbase. These have a capacity of five to six tons and gear ratio of 7.7 to 1. The company is contemplatint the production of similar tractors in all its other truck models.

A six-ton hauling tractor is listed regularly in its catalog by a Chicago truck company. This has a wheelbase of 110 inches, four-speed transmission and 8 to 1 gear reduction in high. It is equipped with a rocking fifth wheel of the company's own design, and with 36x4 inch dual rear tires. The engine is of heavy duty type, especially designed for military truck service and has 4¼ x 5½ inch cylinders. The frame has five cross members reinforced with gusset plates.

Special straight line-drive tractors of two to seven tons capacity are built by a Wisconsin truck company and listed with its standard truck models. It supplies rocking fifth wheels with them and uses a four-speed transmission and gear reduction according to capacity of the unit in which the transmission is mounted.

A Connecticut company that supplied thousands of army trucks to the Allies and the United States Government during the war, manufactures a tractor that is in every respect similar to its standard truck with the exception of wheel-base and length of frame and propeller shaft.

It is indicative of the extent to which the trailer transportation idea has taken hold of the public and the manufacturers that a number of companies are specializing in combinations of tractors and trailers, both of which they build and market themselves. One of these companies, located in New York State, does not build the regular type commercial truck but manufactures a tractor rated at five to ten tons capacity and also a varied line of semi-trailers and four-wheeled trailers to go with it.

The tractor has a permanent driver's cab, 32.4 horse power engine, four-speed transmission with maximum speed of 11 miles per hour, 80-inch wheel-base, dual 36 x 5 rear tires and fifth-wheel attachment. The power plant, radiator, fuel tank and driver's seat are supported on a sub-frame spring-supported at the rear, giving a straight-line drive under all working conditions and reducing vibration of the power plant to the minimum. As one-third of the load is carried on the tractor and two-thirds on the trailer, the makers assert that the tractor can haul four times the load that a motor truck of equal power can carry. By use of extra trailers, which are low in cost compared with extra trucks, the tractor can be kept busy delivering while the additional trailers are being loaded and unloaded. The tractor, under favorable conditions, can haul one or two four-wheeled trailers in addition to the semi-trailer.

One of the most prominent passenger car companies of the country, which began the production of aline of trucks for commercial work after building army trucks for the Government, now reports that it is making arrangements to construct all its truck models in tractor type and expects to get these into production in the very near future. From previous experience of its engineers with other makes of trucks, the company finds it advisable to recommend the use of trailers wherever possible, especially the semi-trailer.

Numerous truck companies besides those referred to specifically are offering tractors as part of their regular lines, while many others build them on order and will probably put them in regular production and list them in their catalogs as the demand for them in-

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THE HIGH PRICE OF MILK

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There are several different classes of official tests. In the short tests the official tester makes determinations of butter fat and quantity of milk at each milking throughout the entire period of from one to seven days. In the more prolonged semi-official tests the daily weighings are performed by the owner, and the official tester conducts each month a two day's test, on the basis of which the monthly average is computed.

A series of monthly tests extending over a period of one year obviously gives a much more reliable indication of the merits of a cow than a short seven-day test. This latter is also regarded with disfavor by most dairymen because of the opportunity it gives for padded records. By special treatment a cow may be prepared for such a short-time test, fattened up for weeks in advance, and then taxed to her limit for one week, the fat accumulated in her body being drawn off at the pail. This not only gives an entirely false estimate of her true capacity - she could not keep up the pace for much more than a week - but it is very apt to injure the cowpermanently both as a milker and as a breeder.

To eliminate the parasite, the unproductive cow, may be the first step towards improving the situation. But destructive measures alone will not avail. In fact, if an uncompromising policy of extermination were carried out, this would entail extremely serious hardships, amounting to catastrophe, for the consuming public. The producer, indeed would be doubly the gainer. For not only would his cost of production be lowered, but at the same time the sudden diminution in supply of milk would temporarily send up the price. For the "boarders," though they produce at a loss, after all do produce. It is therefore really a fortunate thing that through the operation of natural laws of inertia the extermination of boarder cows necessarily will be a gradual process.

Given sufficient time, and the realization of the circumstances set forth above, the demand for milk must automatically lead to the gradual replacement of discarded boarders by better producers. But we cannot fold our hands and wait for this to come about by the operation of chance. More important even than the destructive measures for ridding the herd of parasites is a constructive policy toward the establishment and spread of better stock.

It is simply impossible to overstate the importance to the dairy farmer of securing good stock. This, if it needs any proof, has been shown again and again by experience and experiment. In one series of tests six ordinary dairy herds, in which no efforts had been made to improve the breed, gave an annual output of 175 pounds of butter fat per cow. In the same locality six other herds in which pure-bred sires had been used, averaged 265 pounds of butter fat per year per cow. The cows in the common herds averaged $3.40 profit per year; those in the improved herds, $24.80 per year.

Iowa State College demonstrated that by crossing common cows with pure-bred sires an increase of 71 per cent in milk production could be secured. Examination of records of official tests bring out the same facts in another way. Thus, during the month of October, 1918, for example, no less than 15.4 per cent - nearly one-sixth - of all the Jersey cows in this country which gave over fifty pounds of butter fat in that month, were descendants of one bull on the Island of Jersey, the famous Noble of Oaklands.

A plan for improvement, in order to be practicable, must fall within the scope of the farmer's financial resources. He cannot afford simply to sell out his poor stock and replace it by high-priced pure-bred animals.

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THE HIGH PRICE OF MILK

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Wherever possible, however, he should secure a pure-bred herd sire. If he can also buy one or two pure-bred cows, so much the better. A simple computation shows that, from a nucleus of one pure-bred sire, and two pure-bred cows, it is possible, in six years, to raise a herd of forty head. This is assuming the most favorable condition, that no deaths occur, and that the bull calves are sold and pure-bred heifer calves are purchased out of the proceeds.

If only the price of a bull can be found, then much may still be accomplished by raising on the farm the calves of those cows which the test records or the farmer's own observations have shown to be the best in the herd. It is worth the while to do this even at a temporary sacrifice, as in the case of a certain farmer who applied to one of our leading breeders for a bull calf, but found the price beyond his reach. He finally adjusted matters by selling two of his cows in order to purchase the pure-bred bull calf.

Even if the farmer is quite unable to find the price of a pure-bred full calf he still can help himself by taking advantage of one of the cooperative bull associations that have been formed and through which the service of a bull can be secured for a moderate fee. In certain instances some of our foremost cattle breeders have very generously made a loan of one of their bulls free of charge to such associations. The fact deserves appreciative mention as an act of national service.

Without a good foundation of serviceable stock nothing can be accomplished. But even the best stock can produce to its full capacity only under proper care and management. Modern dairy farming is a big business proposition. It involves problems of crop raising, purchasing, storing, housing, manufacturing of milk products, handling of men; these factors are more or less incidental, and group themselves around the central problem of breeding, rearing, feeding and management of live stock.

The health of the herd can be held at its top notch only by careful attention to many details. If the cows are not fed just right, or if they do not receive the requisite exercise, even in winter, they are apt to develop intestinal and other disorders with an immediate fall in milk production, and the possible loss of the animal. Experience has shown that it is possible, by proper care, to preserve a herd absolutely free not only from tuberculosis, but even from common colds in severe winter weather. It may appear to some farmers a far-fetched refinement to provide each cow with an individual drinking cup, covered to keep out dust; but it is by such measures as this that spread of contagious diseases is reduced to a minimum.

THE GASOLINE LOCOMOTIVE OF THE HIGHWAYS

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creases. One such company in Michigan makes its 1, 2 and 3½-ton chassis in short wheel-bases of 100,110 and 118 inches on special orders for use with semi-trailers and has been making deliveries for six months.

That the demand for trailers and for tractors to use with them is growing rapidly is reflected by the following statement of a district manager for a light truck company: "I am frequently called upon to furnish information concerning the adaptability and profitable employment of trailers to meet various conditions of truck transportation. My work is first and last that of placing our trucks in service, yet I realize that the trailer proposition is so closely related to truck transportation that, in making a true delivery analysis, to ignore the trailer is to work an injustice to efficiency and economy. The trailer has received scant consideration by dealers as against its importance."

PLOWING DEEPER AND DEEPER

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One method is to sub-soil to depth ranging from 18 to 24 inches with an exclusive sub-soiler, and then plow the surface to lesser depth with the common mold-board plow.

The second method consists in using the combination sub-soil plow, an implement of California invention and manufacture. This is a strongly constructed tool with from one to five sets of points. It has a series of sub-soil points reaching to a depth of 24-30 inches, with a series of ordinary plow points set to depths from 10 to 02 inches. Thus the sub-soiling and surface furrowing are performed at one and the same time. A 75 horse-power tractor can easily negotiate a five-standard sub-soiler.

These sub-soil plows are being largely employed on the sugar-beet lands of the Pacific coast, and on the tobacco plantations of the eastern states.

The efficiency of this arrangement may be readily seen when it is taken into consideration that, in the first place, it aids better tilth and in the second it provides means by which air and moisture may both penetrate to increased depths, thus gratifying the natural capacity of the soil, and also permitting a deeper rootage of crops.

The conquest of the irrigation sole is another important matter. In 1910 the irrigated farm acreage in California amounted to 2,664,104 acres; thus may be seen at a glance the importance of breaking up the irrigation sole, which always forms by the constant artificial application of water to the surface.

Irrigation necessarily carries with it a constant need of under drainage by a process of seepage. If this is stopped by the irrigation sole, the land becomes soggy and finally alkaline.

The application of the sub soil plow obviates this difficulty by opening the substrata of the soil to full reception and proper retention of the whole rainfall.

WHAT THE WAR TAUGHT US ABOUT MOTOR TRUCKS

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the anti-friction type that will not need continuous lubrication. The fan belt should be amply large and the tension maintained automatically; or at least there should be provided a substanatil and simple adjustment that is easily reached.

Magneto ignition demonstrated its reliability and efficiency in a way that could not be questioned, and in the writer's opinion it is ideal for trucks because of its simplicity and its independence of other current producers. The carburetors used were of all types; and as is true of all mechanisms, the simplest, non-adhustable types gave the least trouble.

Ofthe many forms of clutches, the three-plate and dry-plate multiple-disk gave best results and stood more abuse than either the leather-faced cone or the multiple disk in oil. Both sliding-gear sets and individual clutch constant-mesh gear-boxes were employed and while the preference is for the latterwhen trucks are to be operated by inexperienced and inexpert personnel, the sliding-gear form survived in a remarkable manner the abuse to which it was subjected.

Considering final-drive systems, those using enclosed driving-gears were the best because the protection afforded by the gear housings kept out the mud and kept in the oil. Worm-drive axles did good work and in cases where trouble was experienced that came under the author's observation, it was due to insufficient lubrication or poor adjustment in repairing, rather than to faulty design. The Hotchkiss drive gave some trouble because the badly overloaded springs often broke under very severe driving or braking torque reaction. The use of radius rods is certainly to be recommended on all heavy-duty trucks.

The point about the class B truck that impressed itself most forcibly on the writer's mind was the automatic oiling of various chassis parts such as spring shackles and hangers, brake-control linkage bearings, universal joints, steering-knuckle bolts, and other parts, by magazines which supplied the oil to the bearing points by wicks. These magazines could be filled with fluid oil and a filling once a month was all that was needed. The cast spring-brackets were cored out and held a good quantity of oil. In cold weather, the oil was thinned with kerosene and fed to the bearings through wicks without much difficulty. The kerosene cuts rust and carries enough oil with it to insure adequate lubrication of points usually neglected. Trucks equipped with the magazine oil-feed were always better lubricated than those using grease cups, which were too easily lost, and besides, the grease passages were found to fill with mud. It would seem that this is a feature which all motor truck makers could incorporate in their chassis construction, since the author's experience would indicate that it is entirely practical in industrial as well as military applications.

Air Service trucks equipped with large pneumatic tires were used advatnageously in bringing down supplies from the base depot to the aviation school where the writer was stationed for a time; and their worth in handling fragile materials at good speeds was amply demonstrated Spare wing frames or fuselages moved on solid-tired trucks were usually thrown enough out of true to call for realigning agter a 200-mile road trip; but they were received in very good condition after covering the same distance on trucks and trailers equipped with air-filled tires; besides this the trip was made at a higher speed. Another feature that can be recommended from actual experience is removable metal disk wheels for light trucks and cast-steel disk or spoked wheels on heavier vehicles.

"I'll say it is!"

PRINCE ALBERT certainly will put frolic into that pet pipe of yours! Why, to listen to a P. A. talk is enough to get you wading deep for a tidy red tin, but to pack that joy'us old jimmy brimful or, roll a makin's cigarette and hit 'er up a notch or two is just going right over the top with your eyes wide open!

Man, man! What P. A. will do for your taste and tongue you sure ought to know! Like the gentleman from Sparrow's Point you'll call P. A. a good egg! You'll smoke a pipe full and talk a bucket full—Prince Albert is such a great, big bunch of smokesunshine!

You 'll put the spurs to every puff of Prince Albert to tempt it to burn your tongue! And, then you'll catch the P. A. cue that it can't bite or parch; that Prince Albert's exclusive patented process frees it from bite and parch! And makes the sky the smoke limit!

Now, talk tricks! Chum it with Prince Albert in your party parlor or in the back bushes; give it high pressure for flavor and fragrance! Put P. A. through your little old taste-test-mill—and—just let that q-u-a-l-i-t-y percolate into your smokesystem!

You'll say it is, too!

PRINCE ALBERT

the national joy smoke

JUST how soon you'll get under P. A.-way depends how fast you can beat it to the nearest place that sells tobacco. There, they'll hand you the toppy red bag, the tidy red tin; the handsome pound or half pound tin humidors—or—that clever pound crystal glass humidor with sponge moistener top that keeps Prince Albert in such perfect condition, as fits your fancy!

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

Experience

The world knows no short-cut to great accomplishment—it comes only as the fruit of pains-taking effort—of experience.

The pilot who guides his ship safely past the dangerous shoals has sailed those waters before.

The manufacturers who build a successful motor truck have learned from cold, hard experience—have solved problem after problem—ironed out mechanical and merchandising tangles—and built better each succeeding year because they *knew* from experience.

Experience of this sort cannot be bought in any market of the world. It is priceless. It can never belong to beginners or transients—it is never known by stock schemers or the insincere.

Experience has built the Federal motor truck as it stands today—without a peer in the field of scientific endeavor—a practical, steel-hard freighter carrying its burdens faithfully and *constantly* at low cost.

The Federal more than ever is making good—even in these exacting times—because its builders have known the experience of a decade.

Federal Motor Truck Company
Detroit, Michigan

The illustration above shows the first Federal ever made. Sold in 1910 and delivered personally by Mr. M. L. Pulcher, President of the Federal Motor Truck Company. This truck is still in daily service after nearly ten years of continuous usage

* * *

Today, Federals are used in every conceivable line of business in all the principal nations and countries throughout the world.

* * *

It is one of the most interesting and gratifying facts in Federal history that 62% of Federal sales have been re-sales to Federal owners so well satisfied with their first purchase that nothing but "Another Federal" will do.

* * *

Since the very inception of the Federal Motor Truck Company, there have been no radical changes in the personnel or policies of the organization.

* * *

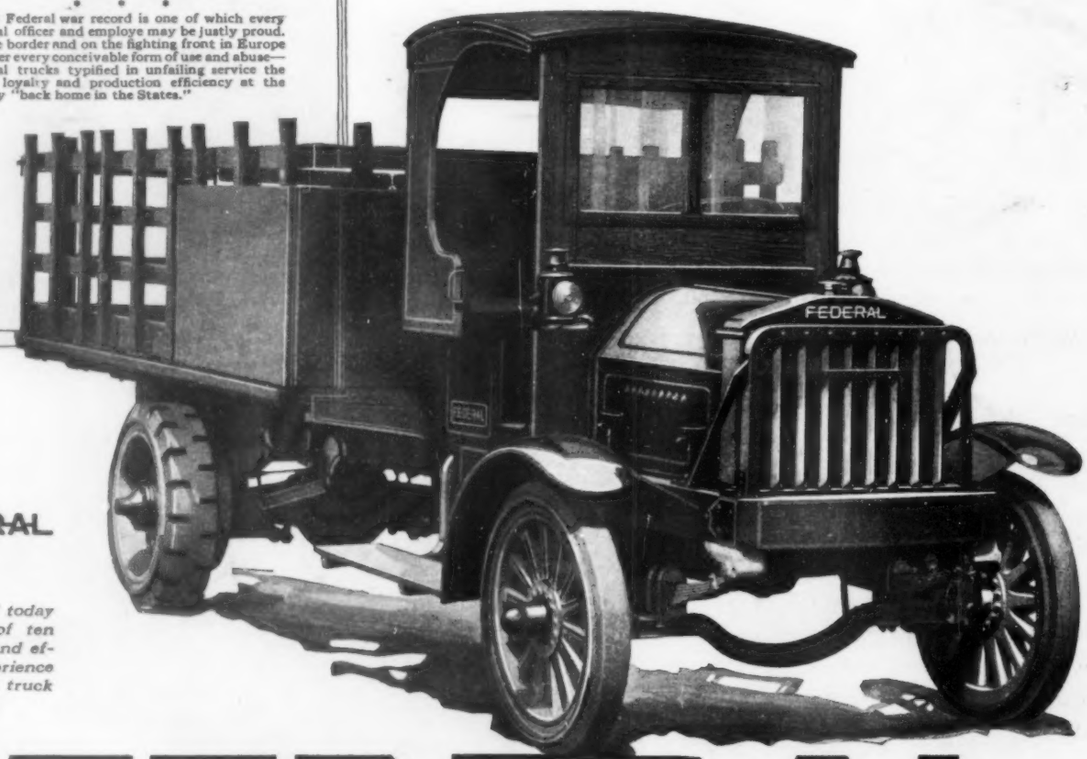
Founded on the broad principles of building the best motor truck that engineering brains and human skill can produce, Federal has grown up with the industry in a solid, substantial way which has required no re-organization or re-financing to maintain its hold on trade or public favor.

* * *

Federal has made no false moves in offering a model or type of motor truck which did not stand the acid test of hardest usage in owners' hands. From Model "A" down to the present line, every truck has represented an increasingly successful series of mechanical and manufacturing achievements.

* * *

The Federal war record is one of which every Federal officer and employe may be justly proud. On the border and on the fighting front in Europe—under every conceivable form of use and abuse—Federal trucks typified in unfailing service the 100% loyalty and production efficiency at the factory "back home in the States."



Another FEDERAL

The Federal today is the fruit of ten years' study and effort—the experience of a decade of truck manufacture

FEDERAL

One to Five Ton Capacities